

1 We Claim:

1. A peptide having an amino acid sequence selected from the group consisting of KRIIQRILSRNS (SEQ ID NO:1), KRIHPRLTRSIR (SEQ ID NO:2), PPRLRKRRQLNM (SEQ ID NO:3), PIRRRKKLRRLLK (SEQ ID NO:4), RRQRRTSKLMKR (SEQ ID NO:5), MHKRPTTPSRKM (SEQ ID NO:6), RQRSRRRPLNIR (SEQ ID NO:7), RIRMIQNLIKKT (SEQ ID NO:8), SRRKRQRSNMRI (SEQ ID NO:9), QRIRKSKISRTL (SEQ ID NO:10), PSKRLLHNNLRR (SEQ ID NO:11), HRHIRRQSLIML (SEQ ID NO:12), PQNRLQIRRHSH (SEQ ID NO:13), PPHNRIQRRLNM (SEQ ID NO:14), SMLKRNHSTSNR (SEQ ID NO:15), GSRHPSLIIPRQ (SEQ ID NO:16), SPMQKTMNLPPM (SEQ ID NO:17), NKRILIRIMTRP (SEQ ID NO:18), HGWZIHGLLHRA (SEQ ID NO:25), AVPAKKRZKSV (SEQ ID NO:26), PNTRVRPDVSF (SEQ ID NO:27), LTRNYEAWVPTP (SEQ ID NO:28), SAETVESCLAKSH (SEQ ID NO:29), YSHIATLPFTPT (SEQ ID NO:30), SYIQRTPTSTLP (SEQ ID NO:31), AVPAENALNNPF (SEQ ID NO:32), SFHQFARATLAS (SEQ ID NO:33), QSPTDFTFPNPL (SEQ ID NO:34), HFAAWGGWSLVH (SEQ ID NO:35), HIQLSPFSQSWR (SEQ ID NO:36), LTMPSDLQPVLW (SEQ ID NO:37), FQPYDHPAEVSY (SEQ ID NO:38), FDPFFWKYSPRD (SEQ ID NO:39), FAPWDTASFMLG (SEQ ID NO:40), FTYKNFFWLPEL (SEQ ID NO:41), SATGAPWKMWVR (SEQ ID NO:42), SLGWMLPFSPPF (SEQ ID NO:43), SHAFTWPTYLQL (SEQ ID NO:44), SHNWLPLWPLRP (SEQ ID NO:45), SWLPYPWHVPSS (SEQ ID NO:46), SWWTPWHVHSES (SEQ ID NO:47), SWAQHLSLPPVL (SEQ ID NO:48), SSSIFPPWLSFF (SEQ ID NO:49),

1 LNVPPSWFLSQR(SEQ ID NO:50), LDITPFLSLTLP (SEQ ID NO:51), LPHPVLHMGPLR
(SEQ ID NO:52), VSKQPYWMWNGN (SEQ ID NO:53), NYTTYKSHFQDR (SEQ ID NO:54),
AIPNNQLGFPEK (SEQ ID NO:55), NIENSTLATPLS (SEQ ID NO:56), YPYDANHTRSPT
(SEQ ID NO:57), DPATNPGPHFPR (SEQ ID NO:58), TLPSPLALLTVH (SEQ ID NO:59),
HPGSPFPPEHRP (SEQ ID NO:60), TSHTDAPPARSP (SEQ ID NO:61), MTPSSLSTLPWP
6 (SEQ ID NO:62), VLGQSGYLMPMR (SEQ ID NO:63), QPIITSPYLPS (SEQ ID NO:64),
TPKTMTQTYDFS (SEQ ID NO:65), NSGTMQSASRAT (SEQ ID NO:66),
QAASRVENYMR (SEQ ID NO:67), HQHKPPPLTNNW (SEQ ID NO:68),
SNPWDSLLSVST (SEQ ID NO:69), KTIEAHPPYYAS (SEQ ID NO:70),
EPDNWSLDFPRR(SEQ ID NO:71), HQHKPPPLTNNW (SEQ ID NO:72),
11 GVVGKLGQRRKKQRRQKK (SEQ ID NO:73),
GRRTKKQRRQKKPPRYMILGLLALAAVCSAA (SEQ ID NO:74) and
GRRTKKQRRQKKPP (SEQ ID NO:75).

2. The peptide of claim 1 wherein said peptide facilitates cellular
16 internalization of a cargo linked thereto.

3. The peptide of claim 2 wherein the peptide has the amino acid sequence
KRIHPRLTRSIR (SEQ ID NO:2).

21 4. The peptide of claim 2 wherein the peptide has the amino acid sequence

1 PPRLRKRRQLNM (SEQ ID NO:3).

5. The peptide of claim 2[✓] wherein the peptide has the amino acid sequence
PIRRRKKLRLK (SEQ ID NO:4).

6 6. The peptide of claim 2[✓] wherein the peptide has the amino acid sequence
RRQRRTSKLMKR (SEQ ID NO:5).

7. The peptide of claim 1 wherein the peptide provides for nuclear
translocation in a target cell.

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8. A peptide-cargo complex comprising a peptide and a cargo wherein the
peptide has an amino acid sequence selected from the group consisting of KRIIQRILSRNS (SEQ
ID NO:1), KRIHPRLTRSIR (SEQ ID NO:2), PPRLRKRRQLNM (SEQ ID NO:3),
PIRRRKKLRLK (SEQ ID NO:4), RRQRRTSKLMKR (SEQ ID NO:5), MHKRPTTPSRKM
16 (SEQ ID NO:6), RQRSRRRPLNIR (SEQ ID NO:7), RIRMIQNLIKKT (SEQ ID NO:8),
SRRKRQRSNMRI (SEQ ID NO:9), QRIRKSKISRTL (SEQ ID NO:10), PSKRLHNNLRR
(SEQ ID NO:11), HRHIRRQSLIML (SEQ ID NO:12), PQNRLQIRRHRSK (SEQ ID NO:13),
PPHNRIQRRLNM (SEQ ID NO:14), SMLKRNHSTSNR (SEQ ID NO:15), GSRHPSLIIPRQ
(SEQ ID NO:16), SPMQKTMNLPPM (SEQ ID NO:17), NKRIILIRIMTRP (SEQ ID NO:18),
21 HGWZIHGLLHRA (SEQ ID NO:25), AVPAKKRZKSV (SEQ ID NO:26), PNTRVRPDVSF

1 (SEQ ID NO:27), LTRNYEAWVPTP(SEQ ID NO:28), SAETVESCLAKSH (SEQ ID NO:29),
YSHIATLPFTPT (SEQ ID NO:30), SYIQRTPTSTLP (SEQ ID NO:31), AVPAENALNNPF
(SEQ ID NO:32), SFHQFARATLAS(SEQ ID NO:33), QSPTDFTFPNPL (SEQ ID NO:34),
HFAAWGGWSLVH (SEQ ID NO:35), HIQLSPFSQSWR (SEQ ID NO:36),
LTMPSDLQPVLW (SEQ ID NO:37), FQPYDHPAEVS Y (SEQ ID NO:38), FDPFFWKYSPRD
6 (SEQ ID NO:39), FAPWDTASFMLG (SEQ ID NO:40), FTYKNFFWLPEL (SEQ ID NO:41),
SATGAPWKMWVR (SEQ ID NO:42), SLGWMLPFSPPF (SEQ ID NO:43),
SHAFTWPTYLQL (SEQ ID NO:44), SHNWLPLWPLRP (SEQ ID NO:45),
SWLPYPWHVPSS (SEQ ID NO:46), SWWTPWHVHSES (SEQ ID NO:47),
SWAQHLSLPPVL (SEQ ID NO:48), SSSIFPPWLSFF (SEQ ID NO:49),
11 LNVPPSWFLSQR(SEQ ID NO:50), LDITPFLSLTLP (SEQ ID NO:51), LPHPVLHMGPLR
(SEQ ID NO:52), VSKQPYYMWNGN (SEQ ID NO:53), NYTTYKSHFQDR (SEQ ID NO:54),
AIPNNQLGFPFK (SEQ ID NO:55), NIENSTLATPLS (SEQ ID NO:56), YPYDANHTRSPT
(SEQ ID NO:57), DPATNPGPHFPR (SEQ ID NO:58), TLPSPLALLTVH (SEQ ID NO:59),
HPGSPFPPEHRP (SEQ ID NO:60), TSHTDAPPARSP (SEQ ID NO:61), MTPSSLSTLPWP
16 (SEQ ID NO:62), VLGQSGYLMPMR (SEQ ID NO:63), QPIIITSPYLPS (SEQ ID NO:64),
TPKTMQTQYDFS (SEQ ID NO:65), NSGTMQSASRAT (SEQ ID NO:66),
QAASRVENYMR (SEQ ID NO:67), HQHKPPPLTNNW (SEQ ID NO:68),
SNPWDSL SVST (SEQ ID NO:69), KTIEAHPPYYAS (SEQ ID NO:70),
EPDNWSLDFPRR(SEQ ID NO:71), HQHKPPPLTNNW (SEQ ID NO:72)
21 GVVGKLGQRRKKQRRQKK (SEQ ID NO:73),

1 GRRTKKQRRQKKPPRYMILGLLALAAVCSAA (SEQ ID NO:74) and
GRRTKKQRRQKKPP (SEQ ID NO:75).

9. The peptide-cargo complex of claim 8 wherein the cargo is selected from
the group consisting of a polynucleotide, a polypeptide, a small molecule, a virus, a modified
6 virus, a viral vector, and a plasmid.

10. The peptide-cargo complex of claim 9 wherein the cargo is a virus
selected from the group consisting of adenovirus, adeno-associated virus, herpes simplex virus,
and retrovirus.

11. The peptide-cargo complex of claim 8 wherein the cargo is selected from
the group consisting of therapeutic proteins, suicide proteins, tumor suppressor proteins,
transcription factors, kinase inhibitors, kinases, cell cycle regulatory proteins, apoptotic proteins,
anti-apoptotic proteins, viral antigens, cellular antigens, differentiation factors, immortalization
16 factors and toxins.

12. The peptide-cargo complex of claim 8 wherein the peptide facilitates
cellular internalization of cargo linked thereto.

21 13. The peptide-cargo complex of claim 12 wherein the peptide provides for

1 nuclear translocation of said peptide-cargo complex in a target cell.

14. The peptide-cargo complex of claim 8 wherein the peptide has the amino acid sequence KRIHPRLTRSIR (SEQ ID NO:2).

6 15. The peptide-cargo complex of claim 8 wherein the peptide has the amino acid sequence PPRLRKRRQLNM (SEQ ID NO:3).

11 16. The peptide-cargo complex of claim 8 wherein the peptide has the amino acid sequence PIRRRKKLRRLK (SEQ ID NO:4).

17. The peptide-cargo complex of claim 8 wherein the peptide has the amino acid sequence RRQRRTSKLMKR (SEQ ID NO:5).

16 18. The peptide-cargo complex of claim 8 wherein the peptide is biotinylated and the cargo is avidin labeled.

21 19. The peptide-cargo complex of claim 11, wherein the cargo is an apoptotic protein selected from the group consisting of p53, caspase-3, HSV thymidine kinase and an antimicrobial peptide.

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20. The peptide-cargo complex of claim 19, wherein the antimicrobial peptide is selected from the group consisting of KLAKLAK (SEQ ID NO:22) and KLAKLAKKLAKLAK (SEQ ID NO:23).

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21. The peptide-cargo complex of claim 19 wherein having an amino acid sequence RRQRRTSKLMKRGGKLAKLAKKLAKLAK (SEQ ID NO:24).

22. The peptide-cargo complex of claim 8 wherein the cargo is glutathione.

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23. A method for identifying peptides capable of cellular internalization of cargo linked thereto, said method comprising:

incubating a target cell with a peptide display library;

isolating internalized peptides presented by said peptide display library

from said target cells and identifying said peptides;

16

synthesizing said peptides;

linking said peptides to cargo to form a peptide-cargo complex;

incubating said peptide-cargo complex with a target cell; and

determining the ability of said peptide to facilitate the cellular

internalization of said cargo into said target cell.

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1 24. The method of claim 23 further comprising determining the ability of said peptide to facilitate the nuclear localization of said cargo.

 25. The method of claim 23 wherein said peptide display library is an M13 phage display library.

6 26. The method of claim 25 wherein said phage display library comprises peptides which comprise 12 amino acids.

 27. The method of claim 23 further comprising biotin labeling the peptides during or after said synthesis of the peptides.

 28. The method of claim 23 further comprising avidin labeling the cargo.

 29. The method of claim 23 wherein the cargo is selected from the group consisting of a polynucleotide, a polypeptide, a small molecule, a virus, a modified virus, a viral vector, and a plasmid.

 30. An expression cassette comprising a DNA encoding a fusion protein comprising a leader sequence, a protein of interest and an internalizing peptide having an amino acid sequence selected from the group consisting of KRILQRILSRNS (SEQ ID NO:1),

1 KRIHPRLTRSIR (SEQ ID NO:2), PPRLRKRRQLNM (SEQ ID NO:3), PIRRRKKLRRLK
(SEQ ID NO:4), RRQRRTSKLMKR(SEQ ID NO:5), MHKRPTTPSRKM (SEQ ID NO:6),
RQRSRRRPLNIR (SEQ ID NO:7), RIRMIQNLIKKT (SEQ ID NO:8), SRRKRQRSNMRI
(SEQ ID NO:9), QRIRKSKISRTL (SEQ ID NO:10), PSKRLHNNLRR (SEQ ID NO:11),
HRHIRRQSLIML (SEQ ID NO:12), PQNRLQIRRHSH (SEQ ID NO:13), PPHNRIQRRLLNM
6 (SEQ ID NO:14), SMLKRNHSTSNR (SEQ ID NO:15), GSRHPSLIIPRQ (SEQ ID NO:16),
SPMQKTMNLPPM (SEQ ID NO:17), NKRILIRIMTRP (SEQ ID NO:18), HGWZIHGLLHRA
(SEQ ID NO:25), AVPAKKRZKSV (SEQ ID NO:26), PNTRVRPDVSF (SEQ ID NO:27),
LTRNYEAWVPTP(SEQ ID NO:28), SAETVESCLAKSH (SEQ ID NO:29), YSHIATLPFTPT
(SEQ ID NO:30), SYIQRTPTSTLP (SEQ ID NO:31), AVPAENALNNPF (SEQ ID NO:32),
11 SFHQFARATLAS(SEQ ID NO:33), QSPTDFTFPNPL (SEQ ID NO:34), HFAAWGGWSLVH
(SEQ ID NO:35), HIQLSPFSQSWR (SEQ ID NO:36), LTMPSDLQPVLW (SEQ ID NO:37),
FQPYDHPAEVSY (SEQ ID NO:38), FDPFFWKYSPRD (SEQ ID NO:39),
FAPWDTASFMLG (SEQ ID NO:40), FTYKNFFWLPEL (SEQ ID NO:41),
SATGAPWKMWVR (SEQ ID NO:42), SLGWMLPFSPPF (SEQ ID NO:43),
16 SHAFTWPTYLQL (SEQ ID NO:44), SHNWLPLWPLRP (SEQ ID NO:45),
SWLPYPWHVPSS (SEQ ID NO:46), SWWTPWHVHSES (SEQ ID NO:47),
SWAQHLSLPPVL (SEQ ID NO:48), SSSIFPPWLSFF (SEQ ID NO:49),
LNVPPSWFLSQR(SEQ ID NO:50), LDITPFLSLTLP (SEQ ID NO:51), LPHPVLHMGPLR
(SEQ ID NO:52), VSKQPYYMWNGN (SEQ ID NO:53), NYTTYKSHFQDR (SEQ ID NO:54),
21 AIPNNQLGFPEK (SEQ ID NO:55), NIENSTLATPLS (SEQ ID NO:56), YPYDANHTRSPT

1 (SEQ ID NO:57), DPATNPGPHFPR (SEQ ID NO:58), TLPSPLALLTVH (SEQ ID NO:59),
HPGSPFPPEHRP (SEQ ID NO:60), TSHTDAPPARSP (SEQ ID NO:61), MTPSSLSTLPWP
(SEQ ID NO:62), VLGQSGYLMPMR (SEQ ID NO:63), QPIIITSPYLPS (SEQ ID NO:64),
TPKTMTQTYDFS (SEQ ID NO:65), NSGTMQSASRAT (SEQ ID NO:66),
QAASRVENYMR (SEQ ID NO:67), HQHKPPPLTNNW (SEQ ID NO:68),
6 SNPWDSLLSVST (SEQ ID NO:69), KTIEAHPPYYAS (SEQ ID NO:70),
EPDNWSLDFPRR (SEQ ID NO:71), HQHKPPPLTNNW (SEQ ID NO:72),
GVVGKLGQRRTKKQRRQKK (SEQ ID NO:73),
GRRTKKQRRQKKPPRYMILGLLALAAVCSAA (SEQ ID NO:74) and
GRRTKKQRRQKKPP (SEQ ID NO:75).

11 31. The expression cassette of claim 30 further comprising expression control
sequences operatively linked to said DNA.

32. A transfer vector comprising the expression cassette of claim 31.

16 33. The expression cassette of claim 30, wherein said leader sequences are
selected from the group consisting of Il-1ra, PTH, VP-22 and related sequences.

21 34. The expression cassette of claim 30 wherein the protein of interest is
selected from the group consisting of apoptotic protein, anti-apoptotic protein, cell cycle

1 regulatory protein, transcription factor, suicide gene product, viral or tumor antigens, and cell
proliferation factors..

35. The expression cassette of claim 30, wherein the encoded fusion protein
comprises an amino acid sequence which facilitates removal of leader sequences therefrom and
6 wherein said leaderless fusion protein comprises an internalizing peptide and a protein of
interest.

36. The expression cassette of claim 30 wherein said fusion protein encoded
thereby is produced and secreted from a cell and subsequently internalized into surrounding cells.

11 37. A method for inducing synovial cell death comprising administering a
peptide-cargo complex to said synovial cell.

38. A method for inducing apoptosis in a tumor cell comprising administering
16 a peptide-cargo complex to said tumor cell.

39. A method for reducing white blood cells in arthritic joints comprising
administering a peptide-cargo complex to said white blood cells.

21 40. The method of claim 37, 38 or 39 wherein the peptide has an amino acid

1 sequence selected from the group consisting of KRIIQRILSRNS (SEQ ID NO:1),
KRIHPRLTRSIR (SEQ ID NO:2), PPRLRKRRQLNM (SEQ ID NO:3), PIRRRKCLRRLK
(SEQ ID NO:4), RRQRRTSKLMKR (SEQ ID NO:5), MHRPTTPSRKM (SEQ ID NO:6),
RQRSRRRPLNIR (SEQ ID NO:7), RIRMIQNLIKKT (SEQ ID NO:8), SRRKRQRSNMRI
(SEQ ID NO:9), QRIRKSKISRTL (SEQ ID NO:10), PSKRLHNNLRR (SEQ ID NO:11),
6 HRHIRRQSLIML (SEQ ID NO:12), PQNRLQIRRHKS (SEQ ID NO:13), PPHNRIQRRLNM
(SEQ ID NO:14), SMLKRNHSTSNR (SEQ ID NO:15), GSRHPSLIIPRQ (SEQ ID NO:16),
SPMQKTMNLPPM (SEQ ID NO:17), NKRILIRIMTRP (SEQ ID NO:18), HGWZIHGLLHRA
(SEQ ID NO:25), AVPAKKRZKSV (SEQ ID NO:26), PNTRVRPDVSF (SEQ ID NO:27),
LTRNYEAWVPTP (SEQ ID NO:28), SAETVESCLAKSH (SEQ ID NO:29), YSHIATLPFTPT
11 (SEQ ID NO:30), SYIQRTPTSTLP (SEQ ID NO:31), AVPAENALNNPF (SEQ ID NO:32),
SFHQFARATLAS (SEQ ID NO:33), QSPTDFTFPNPL (SEQ ID NO:34), HFAAWGGWSLVH
(SEQ ID NO:35), HIQLSPFSQSWR (SEQ ID NO:36), LTMPSDLQPVLW (SEQ ID NO:37),
FQPYDHPAEVSY (SEQ ID NO:38), FDPFFWKYSPRD (SEQ ID NO:39),
FAPWDTASFMLG (SEQ ID NO:40), FTYKNFFWLPEL (SEQ ID NO:41),
16 SATGAPWKMWVR (SEQ ID NO:42), SLGWMLPFSPPF (SEQ ID NO:43),
SHAFTWPTYLQL (SEQ ID NO:44), SHNWLPLWPLRP (SEQ ID NO:45),
SWLPYPWHVPSS (SEQ ID NO:46), SWWTPWHVHSES (SEQ ID NO:47),
SWAQHLSLPPVL (SEQ ID NO:48), SSSIFPPWLSFF (SEQ ID NO:49),
LNVPPSWFLSQR (SEQ ID NO:50), LDITPFLSLTLP (SEQ ID NO:51), LPHPVLHMGPLR
21 (SEQ ID NO:52), VSKQPYWMWNGN (SEQ ID NO:53), NYTTYKSHFQDR (SEQ ID NO:54),

1 AIPNNQLGFPEK (SEQ ID NO:55), NIENSTLATPLS (SEQ ID NO:56), YPYDANHTRSPT
(SEQ ID NO:57), DPATNPGPHFPR (SEQ ID NO:58), TLPSPLALLTVH (SEQ ID NO:59),
HPGSPFPPEHRP (SEQ ID NO:60), TSHTDAPPARSP (SEQ ID NO:61), MTPSSLSTLPWP
(SEQ ID NO:62), VLGQSGYLMPMR (SEQ ID NO:63), QPIITSPYLPS (SEQ ID NO:64),
TPKMTMTQTYDFS (SEQ ID NO:65), NSGTMQSASRAT (SEQ ID NO:66),
6 QAASRVENYMHK (SEQ ID NO:67), HQHKPPPLTNNW (SEQ ID NO:68),
SNPWDSLSSVST (SEQ ID NO:69), KTIEAHPPYYAS (SEQ ID NO:70),
EPDNWSLDFPRR (SEQ ID NO:71), HQHKPPPLTNNW (SEQ ID NO:72),
GVVGKLGQRRTKKQRRQKK (SEQ ID NO:73),
GRRTKKQRRQKKPPRYMILGLLALAAVCSAA (SEQ ID NO:74) and
14 GRRTKKQRRQKKPP (SEQ ID NO:75).

41. The method of claim 37, 38 or 39 wherein the cargo is an apoptotic
protein.

42. The method of claim 37, 38 or 39 wherein the apoptotic protein is selected
from the group consisting of p53, caspase-3, HSV thymidine kinase and an antimicrobial
peptide.

43. The method of claim 41 wherein the antimicrobial peptide has an amino

acid sequence selected from the group consisting of KLAKLAK (SEQ ID NO:22) and KLAKLAKKLAKLAK (SEQ ID NO:23).

44. The method of claim 37, 38 or 39 wherein the peptide-cargo complex has an amino acid sequence RRQRRTSKLMKRGGKLAKLAKKLAKLAK (SEQ ID NO:24).

45. A method for internalizing a GST-fusion protein into a cell comprising administering to said cell a peptide-cargo complex and a GST fusion protein.

46. The method of claim 45 wherein the peptide has an amino acid sequence selected from the group consisting of KRIIQRILSRNS (SEQ ID NO:1), KRIHPRLTRSIR (SEQ ID NO:2), PPRLRKRRQLNM (SEQ ID NO:3), PIRRRKKLRRLLK (SEQ ID NO:4), RRQRRTSKLMKR (SEQ ID NO:5), MHKRPTTPSRKM (SEQ ID NO:6), RQRSRRRPLNIR (SEQ ID NO:7), RIRMIQNLIKKT (SEQ ID NO:8), SRRKRQRSNMRI (SEQ ID NO:9), QRIRKSKISRTL (SEQ ID NO:10), PSKRLLHNNLRR (SEQ ID NO:11), HRHIRRQSLIML (SEQ ID NO:12), PQNRLQIRRHSH (SEQ ID NO:13), PPHNRIQRRLNM (SEQ ID NO:14), SMLKRNHSTSNR (SEQ ID NO:15), GSRHPSLIIPRQ (SEQ ID NO:16), SPMQKTMNLPPM (SEQ ID NO:17), NKIRILIRIMTRP (SEQ ID NO:18), HGWZIHGLLHRA (SEQ ID NO:25), AVPAKKRZKSV (SEQ ID NO:26), PNTRVRPDVSF (SEQ ID NO:27), LTRNYEAWVPTP (SEQ ID NO:28), SAETVESCLAKSH (SEQ ID NO:29), YSHIATLPFTPT (SEQ ID NO:30), SYIQRTPTSTLP (SEQ ID NO:31), AVPAENALNNPF (SEQ ID NO:32),

1 SFHQFARATLAS(SEQ ID NO:33), QSPTDFTFPNPL (SEQ ID NO:34), HFAAWGGWSLVH
(SEQ ID NO:35), HIQLSPFSQSWR (SEQ ID NO:36), LTMPSDLQPVLW (SEQ ID NO:37),
FQPYDHPAEVSY (SEQ ID NO:38), FDPFFWKYSPRD (SEQ ID NO:39),
FAPWDTASFMLG (SEQ ID NO:40), FTYKNFFWLPEL (SEQ ID NO:41),
SATGAPWKMWVR (SEQ ID NO:42), SLGWMLPFSPPF (SEQ ID NO:43),
6 SHAFTWPTYLQL (SEQ ID NO:44), SHNWLPLWPLRP (SEQ ID NO:45),
SWLPYPWHVPSS (SEQ ID NO:46), SWWTPWHVHSES (SEQ ID NO:47),
SWAQHLSLPPVL (SEQ ID NO:48), SSSIFPPWLSFF (SEQ ID NO:49),
LNVPPSWFLSQR(SEQ ID NO:50), LDITPFLSLTLP (SEQ ID NO:51), LPHPVLHMGPLR
(SEQ ID NO:52), VSKQPYWMWNGN (SEQ ID NO:53), NYTTYKSHFQDR (SEQ ID NO:54),
11 AIPNNQLGFPEK (SEQ ID NO:55), NIENSTLATPLS (SEQ ID NO:56), YPYDANHTRSPT
(SEQ ID NO:57), DPATNPGPHFPR (SEQ ID NO:58), TLPSPLALLTVH (SEQ ID NO:59),
HPGSPFPPEHRP (SEQ ID NO:60), TSHTDAPPARSP (SEQ ID NO:61), MTPSSLSTLPWP
(SEQ ID NO:62), VLGQSGYLMPMR (SEQ ID NO:63), QPIITSPYLPS (SEQ ID NO:64),
TPKTMTQTYDFS (SEQ ID NO:65), NSGTMQSASRAT (SEQ ID NO:66),
16 QAASRVENYMHR (SEQ ID NO:67), HQHKPPPLTNNW (SEQ ID NO:68),
SNPWDSLLSVST (SEQ ID NO:69), KTIEAHPPYYAS (SEQ ID NO:70),
EPDNWSLDFPRR(SEQ ID NO:71), HQHKPPPLTNNW (SEQ ID NO:72),
GVV'GKLGQRRKKQRRQKK (SEQ ID NO:73),
GRRTKKQRRQKKPPRYMILGLLALAAVCSAA (SEQ ID NO:74) and
21 GRRTKKQRRQKKPP (SEQ ID NO:75).

47. The method of claim 45 wherein the cargo is glutathione.

48. A kit for internalizing a GST-fusion protein into a cell comprising a peptide-cargo complex.

49. The kit according to claim 48 wherein the peptide has the amino acid sequence selected from the group consisting of KRIIQRILSRNS (SEQ ID NO:1), KRIHPRLTRSIR (SEQ ID NO:2), PPRLRKRRQLNM (SEQ ID NO:3), PIRRRKKLRRLK (SEQ ID NO:4), RRQRRTSKLMKR (SEQ ID NO:5), MHKRPTTPSRKM (SEQ ID NO:6), RQRSRRRPLNIR (SEQ ID NO:7), RIRMIQNLIKKT (SEQ ID NO:8), SRRKRQRSNMRI (SEQ ID NO:9), QRIRKSKISRTL (SEQ ID NO:10), PSKRLHNNLRR (SEQ ID NO:11), HRHIRRQSLIML (SEQ ID NO:12), PQNRLQIRRHSH (SEQ ID NO:13), PPHNRIQRRLNM (SEQ ID NO:14), SMLKRNHSTSNR (SEQ ID NO:15), GSRHPSLIIPRQ (SEQ ID NO:16), SPMQKTMNLPPM (SEQ ID NO:17), NKRILIRIMTRP (SEQ ID NO:18), HGWZIHGLLHRA (SEQ ID NO:25), AVPAKKRZKSV (SEQ ID NO:26), PNTRVRPDVSF (SEQ ID NO:27), LTRNYEAWVPTP (SEQ ID NO:28), SAETVESCLAKSH (SEQ ID NO:29), YSHIATLPFTPT (SEQ ID NO:30), SYIQRTPSTTLP (SEQ ID NO:31), AVPAENALNNPF (SEQ ID NO:32), SFHQFARATLAS (SEQ ID NO:33), QSPTDFTFPNPL (SEQ ID NO:34), HFAAWGGWSLVH (SEQ ID NO:35), HIQLSPFSQSWR (SEQ ID NO:36), LTMPSDLQPVLW (SEQ ID NO:37), FQPYDHPAEVSY (SEQ ID NO:38), FDPFFWKYSPRD (SEQ ID NO:39), FAPWDTASFMLG (SEQ ID NO:40), FTYKNFFWLPEL (SEQ ID NO:41),

1 SATGAPWKMWVR (SEQ ID NO:42), SLGWMLPFSPPF (SEQ ID NO:43),
 SHAFTWPTYLQL (SEQ ID NO:44), SHNWLPLWPLRP (SEQ ID NO:45),
 SWLPYPWHVPSS (SEQ ID NO:46), SWWTPWHVHSES (SEQ ID NO:47),
 SWAQHLSLPPVL (SEQ ID NO:48), SSSIFPPWLSFF (SEQ ID NO:49),
 LNVPPSWFLSQR(SEQ ID NO:50), LDITPFLSLTLP (SEQ ID NO:51), LPHPVLHMGPLR
 6 (SEQ ID NO:52), VSKQPYYMWNGN (SEQ ID NO:53), NYTTYKSHFQDR (SEQ ID NO:54),
 AIPNNQLGFPEK (SEQ ID NO:55), NIENSTLATPLS (SEQ ID NO:56), YPYDANHTRSPT
 (SEQ ID NO:57), DPATNPGPHFPR (SEQ ID NO:58), TLPSPLALLTVH (SEQ ID NO:59),
 HPGSPFPPEHRP (SEQ ID NO:60), TSHTDAPPARSP (SEQ ID NO:61), MTPSSLSTLPWP
 (SEQ ID NO:62), VLGQSGYLMPMR (SEQ ID NO:63), QPIITSPYLPS (SEQ ID NO:64),
 11 TPKTMTQTYDFS (SEQ ID NO:65), NSGTMQSASRAT (SEQ ID NO:66),
 QAASRVENYMR (SEQ ID NO:67), HQHKPPPLTNNW (SEQ ID NO:68),
 SNPWDSLLSVST (SEQ ID NO:69), KTIEAHPPYYAS (SEQ ID NO:70),
 EPDNWSLDFPRR(SEQ ID NO:71), HQHKPPPLTNNW (SEQ ID NO:72),
 GVVGKLGQRRTKKQRRQKK (SEQ ID NO:73),
 16 GRRTKKQRRQKKPPRYMILGLLALAAVCSAA (SEQ ID NO:74) and
 GRRTKKQRRQKKPP (SEQ ID NO:75).

50. The kit according to claim 48 wherein the cargo is glutathione.

21 51. An immunogen comprising a peptide-cargo complex wherein said peptide

1 has an amino acid sequence selected from the group consisting of KRIIQRILSRNS (SEQ ID
NO:1), KRIHPRLTRSIR (SEQ ID NO:2), PPRLRKRRQLNM (SEQ ID NO:3),
PIRRRKKLRLK (SEQ ID NO:4), RRQRRTSKLMKR (SEQ ID NO:5), MHKRPTTPSRKM
(SEQ ID NO:6), RQSRRRPLNIR (SEQ ID NO:7), RIRMIQNLIKKT (SEQ ID NO:8),
SRRKRQRSNMRI (SEQ ID NO:9), QRIRKSKISRTL (SEQ ID NO:10), PSKRLLHNNLRR
6 (SEQ ID NO:11), HRHIRRQSLIML (SEQ ID NO:12), PQNRLQIRRHSK (SEQ ID NO:13),
PPHNRIQRRLNM (SEQ ID NO:14), SMLKRNHSTSNR (SEQ ID NO:15), GSRHPSLIIPRQ
(SEQ ID NO:16), SPMQKTMNLPPM (SEQ ID NO:17), NKRILIRIMTRP (SEQ ID NO:18),
HGWZIHGLLHRA (SEQ ID NO:25), AVPAKKRZKSV (SEQ ID NO:26), PNTRVRPDVSF
(SEQ ID NO:27), LTRNYEAWVPTP (SEQ ID NO:28), SAETVESCLAKSH (SEQ ID NO:29),
11 YSHIATLPFTPT (SEQ ID NO:30), SYIQRTPSTTLP (SEQ ID NO:31), AVPAENALNNPF
(SEQ ID NO:32), SFHQFARATLAS (SEQ ID NO:33), QSPTDFTFPNPL (SEQ ID NO:34),
HFAAWGGWSLVH (SEQ ID NO:35), HIQLSPFSQSWR (SEQ ID NO:36),
LTMPSDLQPVLW (SEQ ID NO:37), FQPYDHPAEVSYS (SEQ ID NO:38), FDPFFWKYSPRD
(SEQ ID NO:39), FAPWDTASFMLG (SEQ ID NO:40), FTYKNFFWLPEL (SEQ ID NO:41),
16 SATGAPWKMWVR (SEQ ID NO:42), SLGWMLPFSPPF (SEQ ID NO:43),
SHAFTWPTYLQL (SEQ ID NO:44), SHNWLPLWPLRP (SEQ ID NO:45),
SWLPYPWHVPSS (SEQ ID NO:46), SWWTPWHVHSES (SEQ ID NO:47),
SWAQHLSLPPVL (SEQ ID NO:48), SSSIFPPWLSFF (SEQ ID NO:49),
LNVPPSWFLSQR (SEQ ID NO:50), LDITPFLSLTLP (SEQ ID NO:51), LPHPVLHMGPLR
21 (SEQ ID NO:52), VSKQPYWMWNGN (SEQ ID NO:53), NYTTYKSHFQDR (SEQ ID NO:54),

1 AIPNNQLGFPEK (SEQ ID NO:55), NIENSTLATPLS (SEQ ID NO:56), YPYDANHTRSPT
(SEQ ID NO:57), DPATNPGPHFPR (SEQ ID NO:58), TLPSPLALLTVH (SEQ ID NO:59),
HPGSPFPPEHRP (SEQ ID NO:60), TSHTDAPPARSP (SEQ ID NO:61), MTPSSLSTLPWP
(SEQ ID NO:62), VLGQSGYLMPMR (SEQ ID NO:63), QPIITSPYLPS (SEQ ID NO:64),
TPKMTMTQTYDFS (SEQ ID NO:65), NSGTMQSASRAT (SEQ ID NO:66),
6 QAASRVENYMHK (SEQ ID NO:67), HQHKPPPLTNNW (SEQ ID NO:68),
SNPWDSLDSVST (SEQ ID NO:69), KTIEAHPPYYAS (SEQ ID NO:70),
EPDNWSLDFPRR (SEQ ID NO:71), HQHKPPPLTNNW (SEQ ID NO:72),
GVVGKLGQRRTKKQRRQKK (SEQ ID NO:73),
GRRTKKQRRQKKPPRYMILGLLALAAVCSAA (SEQ ID NO:74) and
11 GRRTKKQRRQKKPP (SEQ ID NO:75).

52. The immunogen of claim 51 wherein the peptide has an amino acid
sequence RRQRRTSKLMKR (SEQ ID NO:5).

16 53. The immunogen of claim 51 wherein the peptide has an amino acid
sequence GVVGKLGQRRTKKQRRQKK (SEQ ID NO:73).

21 54. The immunogen of claim 51 wherein the cargo is selected from the group
consisting of a polynucleotide, a polypeptide, a protein, a virus, a modified virus, a viral vector,
and a plasmid.

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55. The immunogen of claim 51 wherein the cargo is an antigen.

56. The immunogen of claim 51 wherein the cargo is an HIV protein selected from the group consisting of Gag, Pol, Env, Tat, Nef, Vpr, Vpv, Rev.

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57. A method for eliciting an immune response in a subject comprising administering to a target cell of said subject an immunogen comprising a peptide-cargo complex wherein said peptide has an amino acid sequence selected from the group consisting of KRIIQRILSRNS (SEQ ID NO:1), KRIHPRLTRSIR (SEQ ID NO:2), PPRLRKRRQLNM (SEQ ID NO:3), PIRRRKKLRRLK (SEQ ID NO:4), RRQRRTSKLMKR (SEQ ID NO:5), MHKRPTTPSRKM (SEQ ID NO:6), RQRSRRRPLNIR (SEQ ID NO:7), RIRMIQNLIKKT (SEQ ID NO:8), SRRKRQRSNMRI (SEQ ID NO:9), QRIRKSKISRTL (SEQ ID NO:10), PSKROLLHNNLRR (SEQ ID NO:11), HRHIRRQSLIML (SEQ ID NO:12), PQNRLQIRRHSH (SEQ ID NO:13), PPHNRIQRRLNM (SEQ ID NO:14), SMLKRNHSTSNR (SEQ ID NO:15), GSRHPSLIIPRQ (SEQ ID NO:16), SPMQKTMNLPPM (SEQ ID NO:17), NKRILIRIMTRP (SEQ ID NO:18), HGWZIHGLLHRA (SEQ ID NO:25), AVPAKKRZKSV (SEQ ID NO:26), PNTRVRPDVSF (SEQ ID NO:27), LTRNYEAWVPTP (SEQ ID NO:28), SAETVESCLAKSH (SEQ ID NO:29), YSHIATLPFTPT (SEQ ID NO:30), SYIQRTTPSTTLP (SEQ ID NO:31), AVPAENALNNPF (SEQ ID NO:32), SFHQFARATLAS (SEQ ID NO:33), QSPTDFTFPNPI (SEQ ID NO:34), HFAAWGGWSLVH (SEQ ID NO:35), HIQLSPFSQSWR (SEQ ID NO:36),

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1 LTMPSDLQPVLW (SEQ ID NO:37), FQPYDHPAEVSY (SEQ ID NO:38), FDPFFWKYSPRD
(SEQ ID NO:39), FAPWDTASFMLG (SEQ ID NO:40), FTYKNFFWLPEL (SEQ ID NO:41),
SATGAPWKMWVR (SEQ ID NO:42), SLGWMLPFSPPF (SEQ ID NO:43),
SHAFTWPTYLQL (SEQ ID NO:44), SHNWLPLWPLRP (SEQ ID NO:45),
SWLPYPWHVPSS (SEQ ID NO:46), SWWTPWHVHSES (SEQ ID NO:47),
6 SWAQHLSLPPVL (SEQ ID NO:48), SSSIFPPWLSFF (SEQ ID NO:49),
LNVPPSWFLSQR(SEQ ID NO:50), LDITPFLSLTLP (SEQ ID NO:51), LPHPVLHMGPLR
(SEQ ID NO:52), VSKQPYWMWNGN (SEQ ID NO:53), NYTTYKSHFQDR (SEQ ID NO:54),
AIPNNQLGFPEK (SEQ ID NO:55), NIENSTLATPLS (SEQ ID NO:56), YPYDANHTRSPT
(SEQ ID NO:57), DPATNPGPHFPR (SEQ ID NO:58), TLPSPALLTVH (SEQ ID NO:59),
11 HPGSPFPPEHRP (SEQ ID NO:60), TSHTDAPPARSP (SEQ ID NO:61), MTPSSLSTLPWP
(SEQ ID NO:62), VLGQSGYLMPMR (SEQ ID NO:63), QPIIITSPYLPS (SEQ ID NO:64),
TPKTMTQTYDFS (SEQ ID NO:65), NSGTMQSASRAT (SEQ ID NO:66),
QAASRVENYMR (SEQ ID NO:67), HQHKPPPLTNNW (SEQ ID NO:68),
SNPWDSLLSVST (SEQ ID NO:69), KTIEAHPPYYAS (SEQ ID NO:70),
16 EPDNWSLDFPRR(SEQ ID NO:71), HQHKPPPLTNNW (SEQ ID NO:72),
GVVGKLGQRRTKKQRRQKK (SEQ ID NO:73),
GRRTKKQRRQKKPPRYMILGLLALAAVCSAA (SEQ ID NO:74) and
GRRTKKQRRQKKPP (SEQ ID NO:75)..

21 58. The method of claim 57 wherein the target cell is a mucosal cell.

- 1 59. The method of claim 58 wherein the mucosal cell is a cervical mucosal
cell.